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The Air Line Pilot

September, 1955

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Designing for Accident Survival

Cramped Into Booby-Trapped Cockpits, Pilots Have Hoped For Less Lethal Ones. New Research Holds Promises For That

By A. Howard Hasbrook

Director, Aviation Crash Injury Research, Cornell University

In the last 21 years, approximately 230 pilots and 1,300 passengers have been killed in scheduled domestic airline operations. In addition, more than 140 pilots and 620 passengers were injured.

Thus, a total of about 2,300 persons have sustained some form of injury—fatal, dangerous, non-dangerous, or minor—in airline accidents in the past two decades.

A number of these accidents were non-survivable in nature — involving catastrophic "high angle" impacts at high speed. It is obvious that no amount of crash protective design could have altered the injuries sustained in these crashes.

'Survivable' Accidents

However, some of the other fatal accidents were definitely of a survivable nature. In other words, major portions of the cabins and, in some cases, the cockpits were not demolished by impact. Death and injury in these accidents were not caused by crash force, in itself, but were due to factors, which can be remedied in future aircraft by engineering design. Had we known in 1933, what we are learning today about these factors—and their remedies—through crash-injury investigation and analyses, many past deaths and injuries need not have occurred.

Twelve years of research on causes of injury and the reasons for survival in 100 feet free falls—and accident investigation and analyses of small plane and transport crashes—shows that, under certain conditions, the human body can withstand crash force of unbelievable magnitude—10 to 15 tons—without serious injury.

This new knowledge concerning the strength of the human body can be of value—safetywise—to the air transport industry and to pilots and passengers flying in our future transport aircraft.

Dangers of Higher Speeds

One factor, which will make this new knowledge of increasing importance in the field of crash-survival design, is the fact that future aircraft—jet and turboprop—will probably be more complex in operation, and take-off, approach and landing speeds may be higher. This will result in an increased "exposure" to accidents. In addition, as the transport industry expands, greater numbers of personnel will be involved; this will further complicate the safety problem because people are human beings and human beings make mistakes, despite the best of training in accident prevention.

This is not to imply that accident prevention programs are not worthwhile. Actually, to cope with future safety problems, accident prevention programs must be intensified. However, those who have intimate knowledge of the problem agree that the complexity of operations of new aircraft, coupled with the increasing numbers of aircraft, that will be operated domestically and internationally, will produce more accidents in number, although the accident rate per passenger mile will probably continue to diminish.

A certain number of future accidents will be of a survivable type—particularly those involving aborted take-offs, "short landings," over-shoots, and wheels-up landings and ditchings.

Much can be done to prevent high rates of death and injury in this type of accident—where "contact" speeds of less than 200 miles per hour and impact angles of less than 15 degrees (nose-down) are involved.

Need for Crash-Survival Design

Whether these future survivable accidents are actually survived or not, will depend largely on whether crash-survival design is incorporated in the basic design of future aircraft. However, in order to give design engineers the "up-to-the-minute" data necessary for such design, it will be necessary to continue crash-injury and crash-survival investigations of every survivable crash that occurs—as well as the unbiased analyses and presentation of the data derived from crash-survival accident investigations.

These data, combined with a constantly increasing knowledge of the ability of the human body to resist crash force, will permit improvements in the "state of the art" by which we can utilize the inherent strength of the body and protect it by engineering design.

'Time-Pressure Tolerance'

In past years, the paradox of people

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Ed Modes, Editor

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often being killed in 20 m.p.h. auto crashes, and others sometimes emerging unscathed from 100 m.p.h. airplane crashes, led many to believe that life or death in such incidents was due to luck, fate, or the ownership of a rabbit's foot. Fortunately, in about 99 cases out of 100, survival or death in survivable accidents is not dependent on such intangibles. Instead, injury or lack of injury is primarily dependent on the "time-pressure tolerance" of various portions of the human body: in other words, the magnitude of force, which can be imposed for a given time on a given area of the body without injury.

For example, a person sitting on a chair imposes a load of about 100 pounds on the chair seat. Resistance of the chair bottom causes an equal force to be exerted on the person's buttocks. This is under a 1 G condition. Since this force is distributed over a large area, the load imposed on the buttocks is only about two pounds per square inch.

Ice-Pick Example

However, if an ice-pick were placed on the chair—point up—and the person sat on it, penetration would occur due to the 100 pound load being concentrated on an area only as large as the point on the ice-pick. This loading would be equivalent to about two tons per square inch—under a 1 G condition.

Carrying this example one step further, if the person were suspended head downward, and this load were imposed on the top of his head by the ice-pick, penetration would occur, the brain tissue would be damaged, and death would occur.

Thus, the magnitude of force, the size of the area to which it is applied, and the anatomical portion of the body involved, largely determine whether death, injury or non-injury is sustained.

However, there is still another factor to be considered; this is the rate at which the force is applied. Although too little is known about the reaction of human tissue to "onset" rates of load application, it appears that tissue reacts somewhat like water; if an object makes contact with water at a "slow" rate, the molecules of water have time to displace, permitting penetration with only "normal" resistance. However, if the same object strikes the water at high speed, the water molecules do not have time to move readily and a high relative resistance occurs.

What Human Tissue Can Take

As is the case with water, human tissue seems to have a greater tolerance to pressure under load applications of short duration. Fortunately, this works in favor of crash-survival design because crash loads sustained in survivable accidents are of extremely short duration; recent data indicate that these loads last for intermittant periods of from approximately a 200ths of a second to a one-tenth of a second.

Another point of interest is that, basically, initial speed in itself is not so important as is the rate of "slow down," or G. For example: if an airplane going 100 m.p.h. skids to a stop in 100 feet, the mean deceleration is only 3.4 G. If, however, the airplane "stops" in only 10 feet, the resulting mean deceleration is 34 G.

A pilot in the 100 feet deceleration would impose a load of approximately 578 pounds against his safety belt. In the 10 feet stop, he would apply a load of almost three tons against the belt—and against his hips.

Safety Belts

Safety belt loads approaching this figure have been imposed on pilots without causing serious internal injury. The reason for lack of injury is due to resiliance in the belt and abdomen, the short period of load application, and the fact that the principal load is applied primarily to the hip bones.

Injury in accidents can occur in two ways:

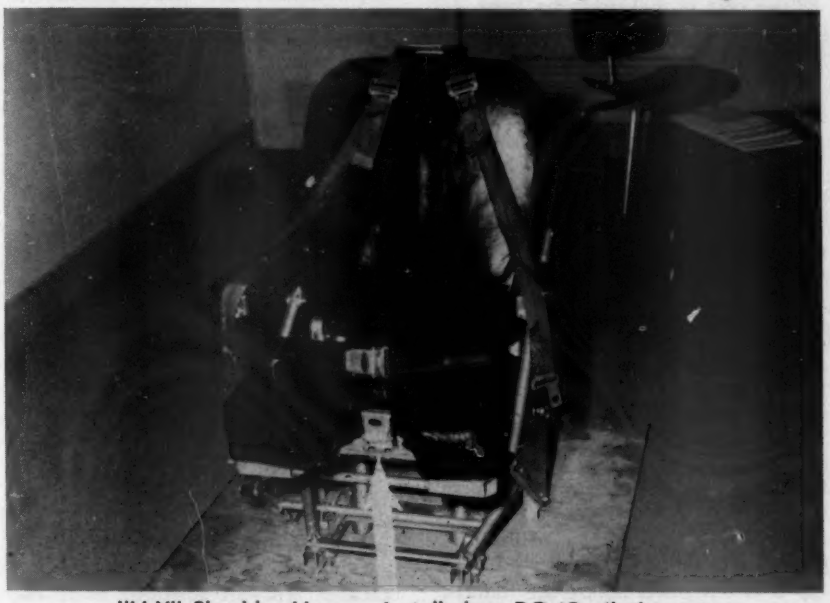
▶ Structure or objects may collapse inward and crush the occupants or, as sometimes happens, some object may strike the head a stunning blow; if this happens in a ditching or if a post-crash fire occurs, death results due to the person's inability to get out of the aircraft;

▶ Persons can be stunned, injured or killed by being thrown against lethal objects, such as hard, rigid seat-backs or an instrument panel.

In those cases where injury occurs due to involvement with collapsing structure, little can be done—design-wise—to prevent injury, although certain cabin components, such as the hat-racks, bulkheads and the cabin walls can be designed to provide additional protection under conditions of partial collapse of cabin structure.

Prevention Possible

However, much can be done to prevent passengers and crew members from sustaining fatal or dangerous injuries inside of relatively intact cabins and cockpits. This can be done by:



"H-V" Shoulder Harness installed on DC-6B pilot's seat.

▶ Keeping the seats and their occupants from being catapulted against lethal objects and structure; this requires that the strength of safety belts, seats, and seat anchorages be as strong and preferably stronger than the basic floor structure of the aircraft;

▶ Delethalize all interior cabin components which can be struck by the passengers while they are held securely by their safety belts and seats. One item, which readily lends itself to delethalized design, is the seat-back which is often struck by the head or chest.

In fact, as a result of Cornell's Aviation Crash Injury Research work, many modern transport aircraft are

now equipped with delethalized, or "soft," seat-backs — and they have proven their value in a number of recent accidents.

The cockpit, unfortunately, does not lend itself to delethalization, due to the "nature of the beast"; however, some improvement could be made in future design in moderating the death-dealing potential of window latches and structure immediately adjacent to the crews' skulls.

A major increase of safety for the crew can, however, be achieved by preventing the crew from striking the lethal objects in the cockpit. This can be accomplished by

- Use of shoulder harness (in addition to the safety belt) and
- Use of lightweight crash helmets.

The potential effectiveness of shoulder harness is shown by the fact that 88 per cent of 800 survivors (who did not wear harness) involved in major damage lightplane accidents, sustained various degrees of injury to the head; 35½ per cent sustained injury to the upper torso.

Shoulder Harness

In comparison, in a recent research study of 69 severe but survivable accidents involving surplus military trainers (including the Vultee BT-13 aircraft) it was shown that when shoulder harness were used there were no cases of dangerous head injury but, in the cases where harness were not used, there were 20 cases of dangerous head injury and 31 cases of lesser degrees of injury to the head.

Few present-day transport aircraft are equipped with shoulder harness for the crew. Why? There are three reasons:

- Too few pilots fully realize the protective value of shoulder harness;
- Too few pilots realize the chances of losing an eye or sustaining a severe or fatal head injury in a minor accident, and
- Present types of shoulder harness are uncomfortable, difficult to put on and take off and too restrictive for normal and emergency operational flight duties.

In regard to the protective value of shoulder harness, most of us are aware of the fact that the military services require shoulder harness—and its use —in all trainer and fighter aircraft; military records show that the use of shoulder harness has drastically reduced the fatal and serious injury rate in survivable military accidents. Since a major portion of these military accidents involve ground "contact" speeds similar to the approach and landing speeds of modern transport aircraft, it would seem obvious that shoulder harness would be just as beneficial to civil transport crews as it is to military pilots.

In regard to protection from lesser injuries in minor accidents, the loss of an eye, due to hard contact with the knobs on the directional gyro or on the throttle, can end the professional career of a pilot—since one-eyed airline pilots are a rarity.

The 'HV' Harness

The third reason for non-use of harness—its discomfort and restrictiveness —appears to have been overcome through Aviation Crash Injury Research's design and development of a new type, called the "HV" Harness.

The lower ends of the nylon harness straps can be "plugged in" to a quick attach-detach unit which is permanently installed in the yoke indent in the seat-pan. This permits attaching or unlocking the harness at any time without the necessity of buckling or unbuckling the safety belt. Thus, the harness can be easily and quickly removed right after take-off, if desired.

The upper ends of the harness straps are attached to a lightly loaded, impact locking reel behind the seat. This reel has an extension cable which permits the pilot to lean forward easily to reach all cockpit controls; thus, the harness is non-restrictive until impact. At impact, the reel locks and prevents the pilot from being thrown forward against the windshield, panel and other lethal objects.

Analyses of several recent survivable transport accidents indicate that the cockpit crew members would not have lost their lives had they been wearing shoulder harness; a number of other pilots would have sustained little or no injury in other accidents.

Light-Weight Crash Helmet

Many present-day cockpits are so "tight" that an additional item of protection — aside from harness — would prove of value. This is the lightweight crash helmet. Several are now on the market but Av-CIR has too little data, at this time, to assess their actual protective value. However, it would seem obvious that any device which serves to deflect and absorb some of the energy of lethal blows from window latches and other hard objects near the head would enhance the pilot's chances of walking away from a crash landing or a ditching.

The susceptibility of jet and turboprop aircraft to rough air and clear air turbulence, due to their high cruising speed, may well make the use of combination buffet-crash helmets an absolute necessity.

Aside from the humanitarian desire to provide maximum crash protection for the crew, the economics of such a measure is important; once an airplane has been ditched or crash landed, the ability of the crew to evacuate the passengers in the shortest time possible may spell the difference between life and death for many of the occupants. Therefore, design efforts to increase crash protection for crew members can result in greater passenger safety.

More Data Needed

One of the basic problems affecting crash-survival design is the need for more precise data on the direction, magnitude, duration and frequency of crash loads imposed on aircraft structures and seats.

This problem is being attacked by the NACA at Cleveland, Ohio, and by the CAA at Indianapolis; the results of this research undoubtedly will provide data of immense value to design engineers.

To sum up:

Although the fatality rate per passenger mile can be expected to decrease — through accident prevention work—accidents will occur.

Some of these accidents will be of a survivable type.

Death or survival for passengers and crew in these survivable accidents will depend, in a large part, on whether crash-survival design factors are integrated in the basic design of future aircraft.

To achieve such integration of design, it will be necessary for all safety segments of interested government agencies, airframe and seat manufacturers, the airlines, and crew member organizations to work together.

To provide the data necessary for crash-survival design, the continued investigation, analysis, and reporting of crash-injury details of survival accidents must be supported.

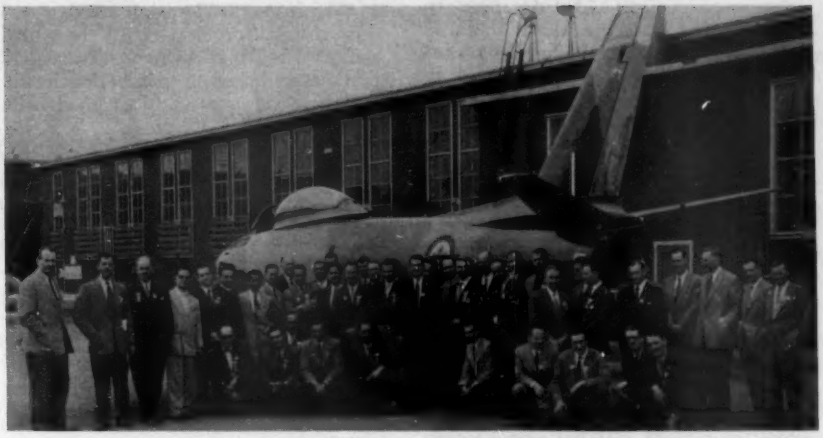
Other allied research work on problems affecting survival design, such as that conducted by the CAA at Indianapolis, and the NACA, must also be supported.

On The Cover

Dummy passengers in various kinds of seats and facing several directions being deliberately crashed to obtain data on Crash Impact Survival in tests at NACA Lewis Propulsion Laboratory, Cleveland. Sensitive instruments, connected to dummies, measured forces exerted on them.

ICAO, World Aviation And You

Today's Line Pilot Has Voice In Global Aviation Through ALPA-IFALPA's Representation In 'World Government Of The Air'



Delegates At 10th IFALPA Conference In Montreal.

By Ed Modes

Editor, THE AIR LINE PILOT

Every five seconds of the day or night, an aircraft is taking off for a regularly scheduled flight somewhere in the world. Before it lands it may well have spanned a continent, or, an ocean, and crossed the borders of many countries. Beneath it, frontiers vanish and the world shrinks.

Aviation has truly reached a global status since the end of World War II. The problems of aviation are seldom any longer purely national in their scope and implications. The war-time transformation of U. S. commercial aviation from continental to world-wide operations has spread American methods, ideas and regulatory practices to the rest of the world. By the same token, it has required Americans to adopt and assimilate the rules and practices of other continents.

Pilots' Role

Pilots have been an integral part of this changing scene and trend toward world-wide aviation. In 1939, before the war, ALPA records show, the commercial air line piloting profession was composed of a small handful of men —only some 1,300. They were flying planes that typically had two engines, weighed 10 tons fully loaded, carried 21 passengers at 170 m.p.h. with a range of about 1,000 miles at 8,000 feet. There was little international aviation, to speak of no real intercontinental aviation. U. S.-Europe Air Service was first inaugurated in 1939, with the flying boats, and took 25½ hours.

Even with the impetus of the war, there were only approximately 5,000 active commercial air line pilots in the U. S.

Growth Cited

The contrast in the last ten years has been great. Today, ALPA numbers close to 10,000 members in its ranks. A typical modern airliner has four engines, weighs 60 tons fully loaded and can carry upwards of 100 passengers. It generates about six times as much horsepower as its pre-war predecessor and cruises at 300 m.p.h. with almost double the cruising range at 30,000 feet. Today's U. S.-Europe air line schedules are 14 hours. By pre-war comparison, today's international civil aviation annually carries 23 times as many passengers, flies 36 times as many passenger miles, transports 70 times as much mail. It has increased the number of aircraft miles flown per year by 630 per cent and lifts five times as many passengers per flight.

The significance of what is happening, cannot be overlooked by the piloting profession. They are flying faster, higher, farther. Foreign pilots fly American-made planes into American airports subject to American rules. U. S. pilots fly into foreign airports, across the length and breadth of the globe, subject to the rules of many countries. Nations are in direct and heated competition for air commerce. The result: the operational problem of air line pilots are becoming common problems among all pilots regardless of borders. National standards are becoming international standards. It is not entirely inconceivable, that the day will some time come, when virtually all aviation standards will be set at the international level.

International Influence

Because of this, the International Civil Aviation Organization (ICAO) and the International Federation of Air Line Pilots Associations, through which the pilots of 22 countries represent the operational viewpoint at the international level, are being constantly drawn closer as a force affecting the Air Line Pilots Association, as an organization, and each and every pilot as an individual professional man.

IFALPA and ICAO are not one and the same, any more than ALPA and the CAB are the same. As a matter of fact, for purposes of broad definition, the relationship in many instances is the same. What ICAO is not, is every bit as important in understanding its operation and function, as a knowledge of what it is. It is not an institute for advanced study, nor a scientific research laboratory, nor a commercial enterprise. It is a specialized agency of the United Nations, an international parliament of the air. IFALPA is a federation of the Air Line Pilots Associations of the world, in which each retains its autonomy and freedom of action, but cooperates in the solution of mutual problems.

ALPA'S Link

How does this ALPA - IFALPA - ICAO relationship concern you, the individual pilot? It means, in the most practical sense, an extension of your representation through channels, which, though they sometimes may appear confused, are the most direct possible approach. Through your member-

ship in ALPA, you are represented at the local and national level. Through ALPA's membership in IFALPA, you are represented in ICAO at the international level. IFALPA's status with ICAO is that of technical advisors and observers. ALPA itself may, on occasion, have the same status in the U. S. delegation to ICAO.

This method of functioning and fostering of the operational viewpoint was described by President Sayen at the tenth IFALPA conference at Montreal in April of this year.

IFALPA, he pointed out, is a means by which pilots from all over the world can bring their individual and collective problems together and attempt to achieve a common and mutual understanding. Then having achieved such an understanding, IFALPA constitutes a vehicle for representing that understanding at international forums and attempting to move it forward to try to achieve a result with it.

This is where ICAO comes in as a force in a pilot's professional life. To fully understand how much of a force, it is necessary to know some of the background, history, and accomplishments of ICAO.

Founded In Chicago

ICAO was founded without much fanfare and with little of the controversy surrounding international conferences, in a meeting room in Chicago in 1945. Fifty countries gathered there to decide how aviation could build institutions of peace.

Their objective, as expressed by the President of the United States: "Let us work together, so that air may be used by humanity to serve humanity."

Operationally, ICAO's direct purpose can be briefly defined as endeavoring to obtain uniformity and safety in world aviation. Because of the nature of ICAO, this purpose must be accomplished through the work of the representatives of the member states.

Organizational Set-Up

There are currently 65 nations represented. Its 21-member council, of which Dr. Edward Warner, of the U. S., is president, is elected every three years. It continually studies and reviews problems with the assistance of its Air Navigation Commission, its Air Transport and Joint Support Committees, its Legal Committee, and its Secretariat working permanently in Montreal. In addition to Montreal, which handles North American problems, ICAO has regional offices in Paris (for the European-African Region), Lima (for South America), Cairo (for the Middle East) and Bangkok (for the Far East and Pacific).

Because its activities are world-wide in scope, regional meetings, designed to take into consideration varying conditions in different parts of the world, are essential to ICAO's operation, particularly in bringing to light deficiencies in the world system of air navigation facilities.

The importance of this latter type of work cannot be underestimated. For example, in various overlapping air navigation regions, some 40,000 facilities are required. When a list of major deficiencies (inadequate runways, inadequate communications, etc.) was compiled, 50 major deficiencies were found. Today, ICAO reports, 4 out of 5 of these have been remedied.

International Traffic

International cooperation through ICAO has made international flight, as we know it, possible. Like the ocean, the air has become a highway for the traffic of all nations. Today's air transport is surrounded and sustained by a network of communications and navigation aids, flight information and traffic control centers. Air Line Pilots may decry the inadequacy of facilities, clamor for more and better ones. There is no denying the need and room for improvement, but much thanks is due to ICAO, that world-wide facilities are as good as they are.

More than 3,500 airports on the world air traffic map have been equipped with facilities to serve aircraft coming from anywhere on the globe.

Chains of weather stations, on land and at sea, probe ceaselessly into the atmosphere to provide up-to-date flight data.

Aircraft in flight and the myriad ground facilities, which sustain them, are linked together by radio systems operating on frequencies shared by world-wide agreement and according to a global plan.

High Standards

Governments, and airlines alike, have pooled their best knowledge and experience to make certain that every nation and every carrier can maintain high standards of operation and service.

They maintain a constant watch to detect, report and remedy any flaw in these facilities.

Where the needs of world air traffic cannot be met by individual governments, international joint support programs fill the gaps: with navigation and traffic control stations in remote areas and weather stations on land and at sea.

For example, let's take one hypothetical flight through the North Atlantic Region, as of the spring of 1955. Sustaining it are 32 regular airports and 42 alternate airports. It navigates with the help of 258 short-distance aids, 24 long-distance aids, and 160 approach aids. It communicates with 127 ground stations linked together by 56 special circuits as well as scores of other aircraft. It is controlled, checked and advised by 71 terminal traffic control services and 44 flight information and area traffic control services. It draws weather information from 71 airports meteorological offices, which derive their data from 9 ocean station vessels, 4 storm-warning centers and hundreds of weather stations.

Technical Assistance

Another aspect of ICAO activity, indirectly having an effect and therefore of particular interest to air line pilots, is the ICAO technical assistance program.

Under this plan, a part of the expanded technical assistance program of the United Nations, ICAO forms and sends out into the field, missions of experts, and undertakes to provide the most favorable training possible for fellowship holders, who will work in the aviation services of the so-called "under-developed" countries of the world.

Agreements for Technical Assistance have been concluded by ICAO with 35 governments. Advisors and instructors recruited internationally from 18 countries have collaborated, and are collaborating, with the national authorities in Afghanistan, Burma, China, Colombia, Costa Rica, Ecuador, Egypt, Ethiopia, Greece, Guatemala, Honduras, India, Indonesia, Iran, Iraq, Israel, Lebanon, Mexico, Pakistan, Panama, the Philippines, El Salvador, Spain, Syria, Thailand and Yugoslavia.

These advisors and instructors are required to assist in establishing or improving sound aviation legislation, telecommunications, air traffic control and weather forecasting and observation systems, as well as in the operation of air routes and maintenance of aircraft and airports.

Accepted Standards

In ten years, civil aviation has developed international "codes of the skies," which virtually all nations accept as the standards and recommended practices for their own laws and regulations.

These international standards cover every phase of civil air operations—

(Continued on Page 13)

Flight Evaluation Of The L-1049G

How Does The 1049G Act In the Air? Perform? Handle? Here Is A Report On Phase II In The 1049G Evaluation

By T. G. Linnert

Head, ALPA Engineering & Air Safety Department

In an era, when new plane development is receiving increased impetus, and modifications and new designs are being made to airline airplanes, pilot evaluation is becoming an increasingly important aspect of ALPA's Air Safety program. Further air line pilot technical conferences with airplane manufacturers has become recognized as mutually beneficial by the manufacturers. In a recent letter to President Sayen, Robert E. Gross, President of the Lockheed Aircraft Corporation, said: "... I reciprocate the cooperative attitude and thoughts that you have expressed and look forward to a closer association as time and new models come to pass."

This pilot aircraft evaluation program with Lockheed aircraft concentrates on one viewpoint—the operational viewpoint, seeking the answers to these primary questions:

- Are there operational problems connected with the plane of which the pilots, who will operate them, should be part in seeking solutions?
- Is it a plane that pilots consider capable of operating safely and efficiently in line use and under actual operating conditions?

Three-Phase Evaluation

In determining the answer to these questions, ALPA subscribes to the theory that aircraft evaluation is a three-step procedure. The three phases involved under ALPA's program are:

- Phase 1—Airplane "make-up" inspection which takes in a study and analysis of the specifications, how it's built, the methods used, and a good look at the components, etc.
- Phase 2—Flight demonstrations of a plane's performance and ability to meet operational requirements.
- Phase 3—Service testing, the in-service and final criteria that determines the ability of any new airplane to conduct an acceptable level of safe and economical airline flying. In service testing, obviously, the air line pilot plays an important role.

This is a report on Phase 2 (performance and flight characteristics) of the L1049G, on which the initial factory and design inspection phase was completed in December of 1954. (See THE AIR LINE PILOT, March, 1955.)

Flight Demonstration Conditions

The flight demonstrations, on which this report is based, were conducted at the Los Angeles International Airport on May 10, 1955. It covers four essential points: 1) take-off; 2) enroute climb; 3) flight handling characteristics; 4) landing.

The take-off demonstrations were made under the following conditions:

- Maximum gross weight, 137,000 lbs.; center of gravity, 24% (most forward for gross weight).
- Wind, 6 MPH.
- Temperature from control tower prior to take-off, 62° F.
- Dewpoint, 53.
- CAR data for runway length for the maximum take-off weight corrected for temperature, wind, and gradient as required.

Take-Off

For the one-engine-inoperative take-off demonstration, the airplane was airborne in approximately 4100 feet and 50 feet high at the end of runway point, a distance of 6309 feet with the No. 1 propeller feathered while still on the runway at V_1 speed (135 MPH, 117 knots) with pull-off at V_2 speed (141 MPH, 123 knots). Altitude was 600 feet one minute after propeller feathering at the V_1 airspeed.

Two minutes of take-off power climb after feathering at V_1 was planned. However, the plane flew into a cloud deck in approximately 1½ minutes at a 900 foot altitude and No. 1 engine was unfeathered, test climb discontinued momentarily, and an all-engine climb made through overcast. At an altitude of approximately 2,000 feet, the plane broke out of the overcast where No. 1 propeller was again feathered to continue the METO power portion of the take-off climb demonstration with one engine inoperative. A 3-engine METO power climb for two minutes resulted in gaining altitude from 2,690 to 3,620 feet or an average rate of climb of 465 feet a minute.

Following the take-off climbs, the airplane was climbed to approximately 16,000 feet to perform a one-engine inoperative climb check at 160 knots (enroute configuration). In the enroute configuration, timing was started at 16,240 feet and data taken for five

No. 1 feathered at V_1 during maximum gross-weight take-off demonstration.

Retirement Study

Western and Northwest Airlines pilots meet with Home Office staff for familiarization of pension programming.

Safety Discussion

Chief Pilots and Safety Chairmen talk over Slippery Runway conditions with ALPA Engineering Staff.

The ALPA

Stro con Sy

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Lake ral Ho

Lake Central pilots receive pins in ce base. L. to r. (standing): . Youree, Cooney, R. W. Clifford, v.p. rations; C Stewart, chairman, Bd. of D s; A. Sabo W. Krieg, member, Bd. of Di s; Capt. D. intendent, Maintenance; G. president patcher.

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...ke O...ral Honors

...ceive 5... pins in ceremonies at LCA's home ...ng): C... Youree, Capt. J. Horn, Capt. T. ...rd, v.p. ...erations; Capt. V. Prose, Dr. R. B. ...l. of Di...s; A. Sabo, Chief Pilot; (seated): ...l. of Di...; Capt. D. Hass, G. Stubbs, super... ...ce; G. ... president; T. Woolley, Chief Dis...

Old And New

Capt. John Scott, who pilots DC-7 Mainliners for United Air Lines, tries controls of 1911 pusher biplane at Denver, under tutelage of Billy Parker, aviation manager of Phillips Petroleum Co., who flies old-timer as a hobby.

Canadian Pilots' Visit

Canadian airline pilots in fraternal visit at ALPA Home Office to discuss mutual problems. L. to r. W. M. Fairey, director, CALPA; Capt. D. L. Beatty, TCA; L. Koch, ALPA; Capt. J. Foy, TCA.

minutes. At the end of five minutes of timing, the airplane had climbed to 16,490 feet, or approximately 50 ft./min.

The 16,000 ft. altitude one-engine inoperative climb was started approximately 32 minutes after take-off. Gross weight at the start of climb was 133,600 lbs.

Enroute Climb Flight Handling

Flight handling characteristics were checked at high gross weight and during descent while water ballast was being dumped, to reach the lower weights to explore landing characteristics.

In general, the hydraulic control boost system on the 1049G airplane provides the pilot with just about the same control pressures as has been the case on previous models of Constellations. This is desirable and has proven quite satisfactory from a control-load standpoint on all models.

The Auto Pilot

Auto pilot handling characteristics were checked at 10,000 foot altitude and 119,000 lbs. gross weight, resulting in the following observations and conclusions:

- Altitude control was used and worked very well during 20° banks.
- Twenty degree bank did not quite give a full "needle-width" turn, 30° bank did.
- Altitude control worked very well up to 20° banks.
- The stabilizing feature of the auto pilot, setting the plane on any course at which the control was neutralized, worked very effectively even with a rapid return to neutral position from a 30° bank.

Stall Data

Stall characteristics of the plane were explored during various clean stalls as well as stalls with landing lights extended and with various gear and flap configurations.

Clean Stalls—High Gross Weights

The following clean configuration stall tests were made, producing the results noted:

During 4-engine METO power climb, the airplane was stalled clean during the blower shift. This was done at 10,000 feet altitude with RPM at 1600, MAP 22 inches. The first stall buffet was noticed at approximately 132k—airplane clean, and ship controlled okay down to 120k with good stall buffeting warning from 132 to 120k. Gross weight approximately 134,500 lbs.

A clean stall was made at 15,700 feet, gross weight 132,948#, 2500 RPM, 19 inches MAP. First stall buffet was at 131k and METO power applied on all four engines. Slight altitude loss was encountered. Good control (landing lights extended).

A clean stall was made at 15,000 feet in a 20° L bank. Gross weight 132,817#, 2500 RPM, 20 inches MAP. First buffet came at 135k and METO power—all four engines—was applied with an altitude loss of 200 feet during recovery. Good control. (Landing lights extended.)

Participants

Participating in the Flight Evaluation tests of the Lockheed 1049G airliner were:

ALPA Representatives: E. Boyce (TWA), Committee Chairman; P. Bracken (TWA), B. Hewitt (TWA), R. Adickes (TWA), M. Cooney (NWA), R. Bird (NWA), T. Linnert (ALPA).

Lockheed Aircraft Company Personnel: R. L. Thoren, Chief of Flight Test; R. E. Wimmer, Lockheed Engineering Pilot; G. E. Fisher, Flight Engineer; J. F. Ware, Flight Test Engineer; A. W. Turner, Flight Test Engineer; G. Krull, Flight Test Engineer; J. Duffenbach, Flight Test Engineer; E. R. Schuberth, Power Plant Laboratory; B. L. Messinger, Thermodynamics Department Engineer; J. P. Stockdale, Engineering Flight Test; E. J. Marsh, Group Engineer, Flight Test Section.

Miscellaneous Stall Data

A clean stall was made except for landing lights extended, gross weight 118,178#. Buffet was encountered at 131k down to a minimum speed of 123k. This was a normal staff buffet and gave no indication of aileron flutter due to landing lights being extended. Good control.

At 66% flaps, landing lights extended, and gear down—a stall occurred at 94k—METO power pull-out simulating poor technique netted a loss of 500% in altitude. This was at a gross weight of 118,098#, 2600 RPM, 27 inches MAP.

At 100% flaps gear down—lights extended—2600 RPM, 25 inches MAP, stalled at 87k. METO power recovery with loss of 175 feet altitude. At approach configuration 66% flap, gear down, in a 30° bank a buffet was encountered at approximately 103k. METO power pull out with 50 feet altitude loss. Gross weight 117,660#. Good control.

A power-off stall on three engines (No. 1 feathered) with gear down and flaps at 66% showed buffeting at approximately 104k. METO power recovery on three engines with a 200 feet altitude loss. Gross weight 117,158#.

Balked Landing Performance

It is recommended on pull-outs that if more than 66% flap have been extended, they should be immediately retracted to 66% position before gear retraction is begun, METO power being utilized from the time the decision is made to go into a pull-out. It is further recommended that no more than 66% flap be extended during an approach until it has been established that the runway is in sight and the approach to landing can be continued and completed.

Data on the "wave-off" demonstrations showed the following:

Four-Engine "Wave-Off"

A four-engine wave-off at 116,884# gross weight with gear down and flaps 66%, approach speed 148k showed an immediate climb of 250 feet with application of METO power and raising of the gear. This was done at 8000 feet altitude.

Three-Engine "Wave-Off"

A three-engine wave-off at 7,000 feet, 116,462# gross weight, with gear down, flaps 66% showed no altitude loss nor settling with three-engine METO power recovery from 135k approach speed, gear retracted. Upon retraction of gear, three-engine METO climb rate was 300 to 500 ft./min. at 161k back to 8,000 feet altitude.

Two-Engine "Wave-Off"

A two-engine wave-off at 6,000 feet, 115,700# gross weight, with gear down, flaps 66% showed ability to hold altitude with take-off power recovery (numbers 3 and 4 engines) while retracting gear and flaps and accelerating to 152k from approach speed of 126k.

Summary

The ALPA 1049G Pilot Evaluation Committee appreciated being given the opportunity to consult with the leading Lockheed Aircraft Company engineers and flight test personnel on the Lockheed 1049G project and is favorably impressed with its performance and flight handling characteristics. We say this, with the reservation, that our visit at the Lockheed factory for flight demonstrations could not possibly be construed as to mean thoroughly going into all phases of the flying qualities of the airplane. All flight demonstrations were conducted at near standard conditions.

Only a period of service testing will determine the real ability of this airplane or any new airplane to conduct an acceptable level of safe and economical airline flying.

Time To Chart A Course

Playing Ostrich With The Airborne Booze And Bottle Problem Bodes Future Trouble, The Author Contends

By Keith Saunders
Editor, National Aeronautics

Speaking from long experience, this writer feels qualified to state that a sociable drink is not a bad thing—in its proper place and at a proper time, such as before dinner in one's own home, in the home of a friend, or at one's club. But I find it hard to dispel a feeling of uneasiness that has been bothering me as a result of the growing practice of serving drinks on commercial airline planes.

I am not prepared to give full credence to reports of drunks fighting in the cabin of an airliner, of stewardesses being molested by a male passenger "in his cups," or of fires started from cigarettes or matches dropped by a careless passenger, who had had "one too many." It is a fact, though, that a responsible airline captain cited such instances in an article titled "Alcoholic Airlines" in the June issue of *The Voice* of the Methodist Board of Temperance. Also, I have been told of a passenger, who consumed no less than six *double* Scotch-on-the-rocks libations on a transcontinental nonstop flight. And I have heard the president of the Air Line Pilots Association term airline drink-dispensing "an alarming problem."

Opposition To Practice

In fact, both ALPA, representing nearly 10,000 airline pilots, and the Air Line Stewards and Stewardesses Association, representing thousands of cabin attendants, are on record as being strongly opposed to the practice. Their opposition stems, of course, from a knowledge of what has happened up to now and what might happen in some unforeseeable future emergency.

The only thought, I seek to raise here, is simply this: the matter of serving drinks on airplanes is fast reaching the point where the airlines must recognize it as an industry matter, to be dealt with on an industry-wide basis.

Airline A announces that its passengers may buy a cocktail or highball before dinner on its planes. Its competitor, Airline B, soon counters with an offer of "one on the house." Airline A then adopts a policy of the first one on the house and all others on the passenger. And so on, *ad infinitum*. The airlines may not have intended at the beginning that it should be that way—that bar service, complimentary or otherwise, should become largely a competitive sales gimmick—but that is about the way it has turned out.

HAROLD S. DYER
920 SHERIDAN ROAD
EVANSTON, ILLINOIS

5/23/55

Air Line Pilots Association International
5440 South Cicero
Chicago, Illinois

Gentlemen:

Whoever within your organization is responsible for opposing the introduction of liquor on commercial flights has earned a medal the size of the prop-arc on the largest thing that flies.

My annual mileage approaches 40,000 and I have over 400,000 logged at this date and the introduction of cocktails for the few buzzards who take advantage of every situation has given me a sour taste for airline management.

It certainly was a stimulating experience to note that your organization stood out solidly against introducing this practice.

May your shadow never grow less!

Sincerely yours,

Harold S. Dyer

Harold S. Dyer

ATA Must Act

It would appear that here is a matter calling for early and constructive action by the Air Transport Association, which embraces all the certificated airlines. Officials of the airlines should sit down together and discuss the alcohol "problem," calmly and objectively, weighing all the pro's and con's. They should obtain some representative sampling of passenger reaction, and should hear what the pilots and stewards and stewardesses have to say on the subject. They then should promulgate an industry policy and code of practice to which all member airlines would pledge their adherence.

Pretending that the serving of drinks on airplanes is not at least potentially a grave problem can only spell trouble in the long run. The protests against the practice are just beginning, and they could conceivably develop into a groundswell of adverse publicity and passenger reaction that could badly hurt the airlines.

Sensible Code Needed

A realistic attitude is called for here. Airlines are transportation, and drinks have been served for years on other forms of transportation, such as steamships and trains; so there is no call here for invoking prohibition. But there seem to be ample grounds for taking a close look at the situation as it exists and as it is developing, and for adopting a sensible code under which the practice can be controlled uniformly on all the airlines.

And this needs to be done now—before the situation gets out of hand and degenerates into a scandal or a tragedy.

Severe Thunderstorm Forecasts

They Cannot Be Pinpointed But Dangerous Areas Can Be Forecast Far Enough In Advance For The Forecasts To Be Operationally Useful

By Lt. Col. Ernest J. Fawbush
Air Weather Service, U. S. Air Force

Severe thunderstorms and their related tornadoes, hail and strong gusts strike each year in greater numbers than most people realize, for only the ones that happen to hit thickly populated areas are highly publicized. Although the storm areas are often large, covering hundreds or even thousands of square miles, the damage is done by individual cells or storms that retain their destructive intensity normally less than an hour. Individual paths seldom exceed 40 miles. In order to give adequate warning, it is necessary to forecast the weather conditions in which severe storms may develop. These forecasts also provide information useful for interpretation of data from electronic devices.

Forecast Possible

Data are never complete and even if they were, it would still be impossible to pinpoint destructive local storms in advance. Nevertheless, it is possible to forecast the thunderstorm situations in which most severe phenomena occur and to outline a reasonably restricted geographical area wherein destruction is probable.

'Great Plains Type'

The density, character and associated weather of severe thunderstorms are naturally affected by the type of air structure in which they form. Investigation has revealed three basic air structures capable of producing severe thunderstorms. The first of the three general types is commonly called the Great Plains Type. The air structure is one with a low moist layer, capped by an inversion with rapid drying upward, then increasing moisture above that. Severe storms associated with this type form in groups or families, set off by some form of squall line and persist for several hours. By squall line, I mean any moving line of thunderstorms not readily circumnavigable, regardless of what caused it. Large hail is usually reported and wide-spread surface damage is common. Mammatus is common. In certain cases, cloud tops may be limited by very strong winds aloft.

'Gulf Coast Type'

The second type we call the Gulf Coast Type. The air is very warm, or hot, and humid to great heights. In a given situation, very severe cells are relatively few and scattered, but the area will contain many showers and thundershowers. The severe storms probably rise to very great heights, but data on upper winds are very scarce. The severe phenomena usually develop during daylight hours.

'West Coast Type'

The third type we call the West Coast Type. The air is relatively cool, but humid to great heights. In this situation, the severe cells usually occur singly and are of short duration, but mammatus, virga and funnels aloft are common in their vicinity. This type is always associated with cold cores aloft and often forms to the rear of cold fronts and squall lines. The vertical extent is probably limited, since this type occurs with strong winds aloft. Associated hail is small, but winds and tornadoes do considerable damage.

The techniques used in severe weather forecasting are empirical in nature, though most, if not all the avenues of attack were suggested by theoretical principles. The maximum emphasis is on the forecast vertical structure of the atmosphere and its correlation with the developing synoptic situation. The methods are based on an adequate sampling of past cases. Our published findings are based on 274 soundings representative of air from which hail of known size fell, 286 soundings of air in which tornadoes formed, and data for 62 non-frontal thunderstorm gusts.

Three Conditions Noted

The first principle of severe weather forecasting is that the air structure must contain a large amount of potential energy. Investigation of the data just mentioned discloses that three basic conditions are necessary:

1. The air must be unstable.

a. The temperature lapse rate conditionally unstable.

b. Adequate moisture available, both in the surface layer and aloft. The distribution of this moisture is very important. The most destructive and persistent storms develop in situations with a dry stratum in middle levels.

2. The wet-bulb freezing level must be above 5,000 feet.

a. Optimum height is 8,000 feet above the ground. Very large hail reaches the surface only when it is within 3,000 feet of this level.

b. When the Wet-Bulb-Zero is less than 5,000 feet above the terrain, no more than small hail forms, thunderstorm gusts add little to the surrounding winds and tornadoes are rare, relatively weak and short-lived.

c. When the Wet-Bulb-Zero is higher than 11,000 feet above the terrain, large hail may be encountered aloft, but rarely if ever does it or strong thunderstorm gusts reach the surface. Tornadoes, too, that reach the earth's surface, are isolated, relatively weak and short-lived.

3. The upper wind field must be suitable.

a. A strong wind core between 12,000 and 20,000 feet adds to the severity of storms and causes severe phenomena to form under or slightly to the right of the position of the core.

b. A strong anticyclonic lateral shear at the same level tends to induce severe phenomena under or slightly to the weaker wind side of the shear.

c. Too strong a vertical shear prevents sustained convective currents and suppresses severe storms.

Formation Of Storms

Generally speaking, thunderstorms will form when the air structure and moisture distribution permit vertical motion with subsequent formation of clouds of vertical development. Within such an air structure, squall lines or areas of thunderstorms will form in the vicinity of low level wind confluence or convergence, lowest convective condensation level, lowest level of free convection, upper cold fronts, including the transitory type formed by evaporative cooling within the middle levels resulting from high level precipitation, surface cold fronts, surface warm

fronts, and other areas of distinctive characteristics that favor vertical currents.

Surface Patterns

The most severe of these thunderstorms are found in the following two places:

1. Under or near the lowest portion of the middle level strong wind core, usually about 14,000 feet.

2. Under or near the lateral shear line, where the anticyclonic shear is very strong. This is also usually most evident at about 14,000 feet.

In particular, severe storms break out where those two zones are associated with one of the following reported or forecast surface patterns:

1. Cold front
2. Squall line
3. Strong thermal area
4. Intersection of squall line and warm front
5. Intersection of squall line and windward side of a thunderstorm area
6. Microcyclone
7. Intersection of strong, moist low level wind axis with a warm front.

Limits In Forecasting

Experience has shown that when sufficient upper wind data are available and reasonable confidence can be placed in the analysis and forecast of the particular situation, forecast areas of the most violent thunderstorms may be limited to a width of approximately 50 miles or less beneath the wind core and to a similar width beneath the anticyclonic shear line. Another 50 miles, added to these widths, may be expected to include the rest of the severe thunderstorms.

The beginning time of these thunderstorms is, of course, a forecast consideration based on the many variables, but usually may be limited to the time of day that convective action is expected to take place. Once formed, squall lines and severe storms as a group will move in the direction of and at 40% of the speed of the mid-tropospheric winds, that is, of the winds at or near 500 millibars. Some individual cells also show a component of movement along the squall line.

Space And Time

The duration of the severe activity will be limited by the potential of the air structure in space and time, according to the following rules:

1. No diminution of the severity of the thunderstorm is expected when the Dew Point Index is negative, regardless of the time of day or night. The Dew Point Index is found by raising the dew point representative of the moist or low layer pseudoadiabatically to 500 mb, then subtracting from the 500 mb temperature.

2. Diminution of the severity may be expected, when the Dew Point Index is positive, beginning six hours after the period of maximum temperatures. Complete dissipation of all thunderstorms may then be expected some two to four hours later.

Most forecasting of intensity is based on the degree of instability shown by the forecast soundings. This is particularly true of hail size and the base of severe turbulence. The latter is taken as the lowest level at which the indicated updraft reaches thirty miles per hour. This, like all our forecasting, is done subjectively by skilled forecasters. We have no special gadgets or machines.

Adequate Reports Needed

It should be obvious from what I have said, that a dense coverage and frequent upper air and surface reports are essential in severe weather forecasting. All weather reports are used in our analysis and forecasting. Sometimes a single observation is critical and provides adequate indications of a developing severe storm condition when its implications are evaluated in relation to the big picture.

Severe thunderstorms and their related phenomena cannot be pinpointed, but dangerous areas can be forecast far enough in advance for the forecasts to be operationally useful. We have issued 2,809 severe weather forecasts from Tinker Air Force Base and their verification is encouraging. We are learning more every day and we believe we improve every year.

We are also interested in forecasting turbulent layers within the squall line and developing some sort of turbulence parameter which can be interpreted in terms of stress and strain placed on various types of aircraft. This would, of course, depend upon gross weight and air speed when penetrating the thunderstorm.

ICAO, World Aviation and You . . .

(Continued from Page 6)

from the airworthiness and maintenance of the aircraft and the qualifications of the crew, to procedures in flight and clearances through border controls.

They also provide an international language. Every symbol on an aircraft charts means the same thing to all who use it. There is agreement on units of speed and dimension and on many kinds of identification codes. Even a new international spelling system has been devised for use in radiotelephony.

The aim of these agreements has been to assure the public safety under all circumstances—not only, for example, when an Australian pilot is flying a domestic service within his own country, but also when an Indonesian pilot is flying a British aircraft into a Ceylonese airfield, on a French landing aid manned by a Greek.

All Aspects

ICAO's activities by no means end at this point. It is concerned with every aspect of international air transport. These, too, have an impact on the pilot because they directly affect the industry, of which the air line piloting profession is such a vital part.

Each nation, large or small, has full sovereignty over the air space above it and full control over the air services offered its people.

Any kind of international air transport is thus impossible unless there are agreements between nations on how air traffic can be carried on between them.

In the past ten years, however, the nations have devised peaceful means of exchanging air traffic rights and of making competition constructive, rather than destructive.

Questions of whether the airline of one country may fly into the airports of another and pick up traffic bound for still other countries are settled by negotiation according to standard forms of agreement. There are today hundreds of such pacts, involving more than 60 nations.

Fares And Rates

Questions of fares and rates, in which each government has the final word on what its own airlines shall charge and on what its people shall be charged by other airlines, are also determined by international agreement — through annual conferences of the airlines themselves, whose unanimous resolutions must be approved by governments.

Still other agreements have been necessary to make international flight legally possible, by reconciling the differences between national laws governing contracts, liability, property rights and commercial practices, and to avoid conflicts of taxation and the like.

International Air Transport is most useful to the traveller and shipper

when he can book himself or his goods, simply and easily, from anywhere he happens to be to any of the 3,500 cities on the air map—by the fastest, cheapest and most direct routing possible.

Voluntary Agreement

By voluntary international agreement, the airlines have been able to knit their individual routes into a single, worldwide system—without the slightest change in the nationality, character or ownership of any individual company.

These agreements, most of which must be approved by governments to become effective, cover virtually every phase of an air traffic transaction, from the birth of the idea to the completion of the trip:

- They coordinate timetables, to help passengers make the best connections possible.
- They make certain that advertising will be accurate and fair.
- They establish the qualifications of the agents, who sell passenger and cargo space to the airplanes on behalf of the scheduled airlines.
- They provide a universal reservations code by which bookings can be made and confirmed anywhere in the world.
- They assure that all fares, rates, conditions of carriage and other factors, which determine how the traveller must pay and what kind of treatment he can expect, will be known in advance—and that they will be the same for him as for everyone else.
- And they guarantee that the single ticket or air way bill issued by one airline will be honored by more than a hundred others, no matter how long or complicated the voyage may be.

In a world still beset by foreign exchange controls and currency fluctuations, international air transport must be able to sell space in the traveller's own currency—and to bring the proceeds home to pay its own bills in its own money.

International Clearing House

An International Clearing House, maintained with the cooperation of governments, allows the airlines to transact international business in a bewildering variety of currencies, without risking substantial losses through fluctuation, premiums and delays.

Less red tape is one of the watchwords of international civil aviation. Governments and airlines have not only cooperated to create regulations for world flight where they have been needed—they have also joined forces to eliminate them where they are unnecessary.

Battling 'Red Tape'

A world-wide facilitation campaign is being constantly waged against cumbersome and overlapping requirements for paperwork, procedures and controls and other formalities at customs, immigration, quarantine and other control points. Its objects are:

- To make certain that the speed of air transport will not be slowed down by practices developed for sailing ships and caravans, steamers or railways, to streamline the internal procedures of both government administration and airline operation.
- To abolish practices, which discriminate against air transport alone.
- To assure that the bona fide businessman, tourist and student will be welcomed everywhere as a person

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While the rooted practices of many centuries cannot easily be changed overnight, the results of this campaign are already evident in faster clearances, less paperwork, less waiting and less cost—to governments, airlines, travellers, shippers and taxpayers alike.

In the past ten years, requirements for visas between many countries have been abolished.

Many hundreds of different forms required of aircraft, passengers, crews and goods have been replaced by single, simpler internationally standardized documents.

Streamlining of paperwork has reduced the cost of airline operations by millions of dollars a year.

Time Saved

New procedures at North Atlantic terminals alone have saved the travelling public more than 750,000 man-hours of waiting-time annually.

The time required to clear international flights at departure and landing has been cut in half.

Improved regulations have reduced the cost of customs, immigration and quarantine administration.

For the peoples of the world international civil aviation has become a vital and mature public service—and an important part of the world economy.

The operating revenues of air transport have tripled in ten years, while the airlines have become important contributors to national treasuries—more than 13 per cent of what the airlines collect goes back to governments.

Jobs For Millions

The payrolls of airlines and government aviation agencies provide direct livelihoods for more than a million families, while their purchases of fuel, equipment, services and supplies help to give jobs to millions more. At the same time, international civil aviation has made revolutionary changes in the lives of great masses of the world's peoples.

ICAO, which celebrated its tenth anniversay this year, has played an important part in all of this, and will undoubtedly prove of increasing importance to world aviation, and to pilots, as time goes by.

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The nest is empty, the nest-egg remains . . . This Victor Keppler photo represents a paradox. Last spring's nest is empty, the birds flown. Think of it as representing the days of leisure, when the young people are launched and the older ones too can take wing, thanks to the steady accumulation of the family "nest-egg," United States Savings Bonds, bought regularly on Payroll Savings.